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A Scandinavian audit of hospitalizations for chronic obstructive pulmonary disease

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Summary
In Scandinavia no large audits of hospitalizations for chronic obstructive pulmonary disease (COPD) have been performed, and data on adherence to national guidelines are scarce. The aims of the present study were to audit hospitalizations for COPD exacerbations in three Scandinavian hospitals with respect to incidence, patient population and standards of hospital care.

Retrospectively all hospitalizations in the Departments of Internal and Respiratory Medicine in Östersund Hospital (Sweden), Aalesund Hospital (Norway) and Trondheim University Hospital (Norway) from Jan 1 to Dec 31, 2005, with discharge ICD-10 diagnoses J43–J44, J96 + J44 or J13-18 + j44 were registered. A total of 1144 admissions (731 patients) were identified from patient administrative systems and medical charts.

Among the admitted patients 27% were >80 years old, >50% had COPD stage III or IV, and 14% had respiratory acidosis at admittance. Patients with 3 or more admissions (13%) during 2005 accounted for 36% of all hospitalizations. One third of the patients were current smokers. Non-invasive ventilation was used in 14% of the admissions, with large variation between centres. In-hospital mortality was 3.7%.

In this first large Scandinavian audit of COPD-hospitalizations, all centres had low in-hospital mortality. We consider this as an indication of good clinical practice in the three studied centres and possibly due to the frequent use of non-invasive ventilation.

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Background and aims

Chronic obstructive pulmonary disease (COPD) is a prevalent disease and is expected globally to be the third leading cause of death by 2030.[1] COPD patients experience frequent exacerbations, and severe exacerbations requiring hospitalization are associated with significant in-hospital and post-discharge mortality.[2–6] The annual rate of hospitalizations for COPD is about 200/100,000 in Sweden[7] and 400/100,000 in USA.[8] Hospitalizations are significant contributors to costs related to COPD.[9]

No large audits of hospitalizations for COPD have been performed in Scandinavia, and data on adherence to national guidelines are scarce. Audits in The United Kingdom (UK), USA and Australia have shown large variations in in-hospital care for COPD exacerbations.[2,3,10–13]

Although there are some differences in the organization of care, the health care systems in Sweden and Norway have similar funding with public hospitals, and in-patient treatment is free of charge. National guidelines for prevention, treatment and care for COPD patients exist in both Sweden and Norway.[14,15]

The aims of the present study were to audit hospitalizations for COPD exacerbations in three Scandinavian hospitals with respect to incidence, patient population and standards of hospital care.

Methods

A retrospective study was conducted of all hospitalizations for COPD exacerbations from Jan 1 to Dec 31, 2005 in the Departments of Internal and Respiratory Medicine in Trondheim University Hospital (Norway), Aalesund Hospital (Norway), and Östersund Hospital (Sweden).

Trondheim University Hospital is the main hospital in mid-Norway with both a local and regional catchment area. It has a respiratory department with an intermediate respiratory care unit where non-invasive ventilation (NIV) is administered. *Aalesund Hospital* is a regional hospital, and patients with respiratory diseases are admitted to a ward for general Internal medicine. NIV is administered on the ward or in the intensive care unit. In Norway patients are usually evaluated by a general practitioner before admittance to in-hospital care. *Östersund Hospital* is the only hospital in the county and has its own respiratory ward. NIV is exclusively given at the intensive care unit. In Sweden patients are not required to consult primary health care before seeking emergency care and hospital admittance. Additional description of the participating centres is presented in Table 1.

Cases were identified from patient administrative systems and medical charts were reviewed by the authors or a medical student. Study inclusion criteria were patients discharged in 2005 with one of the following ICD-10 discharge diagnoses: I) main diagnoses J43–J44 (emphysema and chronic obstructive pulmonary disease), irrespective of secondary diagnosis, II) main diagnosis J96 (respiratory insufficiency) + secondary diagnosis J44, or III) main diagnosis J13-18 (pneumonia) + secondary diagnosis J44. Inclusion criteria II and III were used to avoid case selection bias between the three centres. The coding practice varied between the three centres due to local tradition and differences in reimbursement systems.[16] During review of medical charts, cases with no evidence of COPD, ie misdiagnosis, were excluded.

Study variables were chosen in order to audit patient characteristics, in-hospital care and in-hospital outcomes and were based on previous international audits and national clinical guidelines. Study variables and proportion of missing data are presented in Table 2.

Statistical analyses were performed with STATISTICA data analysis software system, version 9.0, StatSoft, Inc. ANOVA was used to compare differences in patient age and length of stay between hospitals. Pearson Chi2-test was used to compare differences between centres regarding categorical variables. To compare the crude- and age-adjusted incidence between centres a 2-sample test for equality of proportions with continuity correction was done using R: A language and environment for statistical computing, version 2.9.2.[16] A p-value <0.01 was considered statistically significant.

Results

In total, 20 cases were excluded from analysis due to misdiagnosis. A total of 1144 admissions (731 patients) were included in the study (Table 3). The distribution (number and percentage) of patients with the three main discharge diagnoses were 753 (66%) with J43–J44, 78 (7%) with J96 + J44, and 313 (27%) with J13-18 + J44, respectively.

The patient mean (SD) age was 73.0 (10.0) years, without any significant differences between the centres. In 27% of the admissions, the patient's age was above 80 years. In 92% of the cases, the patient was living at home. Patients with 3 or more admissions (13%) during 2005 accounted for 36% of all hospitalizations. There were significant differences between the centres with respect to the distribution of GOLD stage with the highest percentage of stage IV patients in Östersund (35%) compared to 25% in Trondheim and 12% in Aalesund. In total, 14% of the patients had respiratory acidosis at admittance. More characteristics on patient status at admittance are presented in Table 3.

The most common COPD-related medication at admittance was inhaled anticholinergics, which was used

Table 1 Participating hospitals.

	Trondheim (n)	Aalesund (n)	Östersund (n)
Population	229,096	91,703	127,424
Hospital beds	1053	348	325
ICU beds	12	10	8
Respiratory consultants	9	1	5

Table 2 Recorded variables and the amount of missing data.

	Variable	Categories	Missing data (%)
Admittance status	Age	Years	0
	Gender	Male, female	0
	Referral for admittance	None,[a] primary care, respiratory specialist, other	11.2
	Social status	Home, institutionalized	0.7
	Number of previous COPD-hospitalization at same hospital	0, 1–2, >2	0.2
	Pre-admission spirometry accessible in patient medical record	Yes, no	28
	Pre-admission GOLD[b]-stage	I, II, III, IV	28
	Smoker	Current, ex-smoker, never smoker	4.8
	Arterial blood gas	Yes, no	18.8
	Leg oedema	Yes, no	14.6
COPD-related medication at admission	Inhaled anticholinergics	Yes, no	1.0
	Short acting β_2 agonist	Yes, no	1.0
	Long acting β_2 agonist	Yes, no	1.0
	Inhaled corticosteroids	Yes, no	1.0
	Fixed combination inhaled corticosteroids + long acting β_2 agonist	Yes, no	1.0
	Theophylline	Yes, no	1.0
	Oral steroids	Yes, no	0.8
	Long term oxygen therapy	Yes, no	0.3
In-hospital care	Electrocardiogram	Yes, no	1.7
	Spirometry	Yes, no, GOLD[b]-stage	0.3
	Treatment with antibiotics	Yes, no	0.5
	Treatment with systemic steroids	Yes, no	1.0
	Treatment with oxygen therapy	Yes, no	13.8
	Chest x-ray	Yes, no	0.1
	Physiotherapy	Yes, no	1.9
	Non-invasive ventilation	Yes, no	0.3
	Invasive ventilation	Yes, no	0.3
Discharge information	Length of stay	Days	0
	In-hospital mortality	Yes, no	0

[a] Patient seeks emergency care without prior contact with health care.
[b] Global Initiative for Chronic Obstructive Lung Disease.

by 67% of the patients (Table 4). In 18% of the admittances, patients were on long-term oxygen therapy (LTOT). More data on medication at admittance are presented in Table 4.

In all three centres, 3% of the admissions required the use of invasive ventilation. The use of NIV varied significantly between the three centres, from 8% to 22% (Table 5). In 9% of the cases no chest x-ray was done. Chest x-ray revealed a pulmonary infiltrate in 61% and no pulmonary infiltrate in 30%of the cases. Fourteen percent of the cases with main ICD-10 discharge code J43–J44 had a pulmonary infiltrate on chest X-ray, whereas 29% of those with main discharge code J13-18 had no pulmonary infiltrate. Spirometry during hospitalisation was done in 22% of the admissions. Data on pre-admission GOLD stage was lacking in 28% of all cases. In 19% of all admissions, the patient was discharged without any knowledge of her previous or present lung function. Additional data on in-hospital care are presented in Table 5.

The overall in-hospital mortality was 3.7% and the mean (SD) length of stay was 8.6 (8.2) days, with no statistical differences between the centres. In 25% of the cases the length of stay was longer than 10 days.

Discussion

Key results

In the present study, COPD-exacerbations requiring hospitalizations in three hospitals in Norway and Sweden were audited. A total of 1144 medical charts from 731 patients discharged with ICD10-diagnoses J43–J44, J96 + J44 or J13-18 + j44 during 2005 were reviewed. To the best of our knowledge, the present study is the first large clinical audit of Scandinavian COPD-hospitalizations.

In the present audit the patients were elderly and equally distributed between genders. In one third of the

Table 3 General data and patient status at admittance.

		Trondheim	Aalesund	Östersund	Total	*p*-value
Hospitalizations (n)		559	260	325	1144	
Frequency of admittance (/100,000 aged ≥ 40 years)		539	610	471	531	[a]
Crude frequency of admittance (/100,000)		244	284	255	255	[b]
Female (%)		53	35	53	49	0.000
Age (%)	<50	3	3	0	2	0.011
	50–59	8	7	7	8	
	60–69	20	21	28	22	
	70–79	43	38	39	41	
	>80	26	31	26	27	
Current smoker (%)		35	35	25	32	0.000
Number of previous COPD-hospitalization at same hospital (%)	None	23	27	24	24	0.000
	1–2	22	24	24	23	
	≥3	55	49	49	52	
GOLD stage based on previous spirometry (%)	I–II	21	25	8	18	0.000
	III	32	36	19	30	
	IV	24	12	35	24	
Respiratory acidosis (%)[c]		13	10	9	12	0.035
Leg oedema (%)		18	28	25	22	0.010
Referral for admittance (%)	None[d]	14	14	65	31	<0.001
	Primary physician	78	72	23	59	
	Pulmonary physician	3	8	10	6	
	Other	5	5	1	4	

[a] Trondheim vs. Aalesund $p = 0.11$, Trondheim vs. Östersund $p = 0.056$, Aalesund vs. Östersund $p = 0.002$.
[b] Trondheim vs. Aalesund $p = 0.049$, Trondheim vs. Östersund $p = 0.55$, Aalesund vs. Östersund $p = 0.22$.
[c] Patient seeks emergency care without prior contact with health care.
[d] pH ≦ 7.35, pCO2 > 6 kPa.

admissions, the patient was a current smoker. Patients with severe COPD, as well as patients with frequent admissions accounted for a significant proportion of the hospitalizations. Non-invasive ventilation was frequently used, with large variation between centres. All three centres had low in-hospital mortality.

Study limitations

The present study design is associated with some limitations that may have affected the study results.

Firstly, medical records with main discharge diagnoses J43–J44, J96 + J44 or J13-18 + j44 were included. These are common combinations used in Scandinavia for COPD exacerbations. Inclusion of admissions with pneumonia as main diagnosis and COPD as secondary diagnosis might increase the heterogeneity of the material, but it reduces the risk of case selection bias between the three centres. However, it is possible that the present study cohort including COPD-exacerbation with pneumonia represent a population with higher morbidity compared to a large US COPD audit, where cases with pneumonia as secondary diagnosis were excluded.[2]

Secondly, as very few cases of COPD exacerbations were managed outside the Medical or Pulmonary Departments, admissions to other departments were not reviewed.

Thirdly, interpretation of historical data will always be limited by a certain degree of missing data. The collection of historical data from medical records relies on good medical documentation. In particular, absence of documentation does not necessarily mean absence of process.

Table 4 COPD-related medication at admittance.

	Trondheim (%)	Aalesund (%)	Östersund (%)	Total (%)	*P*-value
Short acting β_2 agonist	68	64	56	64	0.001
Long acting β_2 agonist	10	7	20	12	0.000
Inhaled corticosteroid	15	14	35	20	0.000
Fixed combination inhaled corticosteroid + long acting β_2 agonist	47	55	40	47	0.002
Theophylline	14	25	11	16	0.000
Oral steroid	34	41	24	33	0.000

Table 5 In-hospital management.

	Trondheim (%)	Aalesund (%)	Östersund (%)	Total (%)	*P*-value
Non-invasive ventilation	14	22	8	14	0.000
Antibiotics	68	71	60	66	0.007
Systemic steroids	83	77	78	80	0.086
Chest x-ray	98	97	75	91	0.000
Electrocardiography	80	77	72	77	0.010
Arterial blood gas	79	89	80	82	0.002
Physiotherapy	19	23	10	18	0.000
Oxygen therapy	94	85	86	89	0.000

However, taking into account the increasing demands from the health authorities on medical documentation during the last decade, the authors believe that in the present study the proportion of missing data is relatively low.

Interpretation

In Trondheim and Östersund the patients were equally distributed between genders. However, in Aalesund, significantly fewer females than males were admitted to hospital for COPD. The explanation for this finding is beyond the scope of this paper and will be addressed in a future study.

Compared to the Norwegian centres, a smaller proportion of the admitted COPD patients in Östersund were current smokers. This is probably due to the lower prevalence of smoking in Sweden. In 2005, the prevalence of daily smokers was 16% in Sweden versus 25% in Norway.[17,18]

Frequent hospital admittances are common among COPD patients. In the present study, patients with three or more previous COPD-admissions during 2005 (13%) accounted for 36% of all COPD-hospitalizations. Moreover, patients with no previous COPD-hospitalization accounted for only 24% of the admittances. Interestingly, a similar proportion (29%) was found in a UK audit.[10]

A majority of the admitted patients had severe or very severe COPD (GOLD III or IV). Moreover, 18% of the admitted patients had LTOT. In a Danish study from 2000, 16% of the patients admitted because of COPD had LTOT.[19] In an UK audit on COPD exacerbations published 1997, among the first time admissions 6% of the patients had LTOT whereas 29% the readmitted patients had LTOT.[10]

There were significant differences between the centres in the patients use of COPD medication at admittance. In the two Norwegian centres, a significantly higher proportion of the patients had oral steroids at admittance than in Östersund. This difference is probably due to a larger proportion of Norwegian patients evaluated and treated by a primary care physician before referral for admittance. In Östersund, the majority of patients came directly to the emergency unit without prior contact with the primary health care.

NIV was administered in 14% of the COPD-hospitalizations, with large variations between the centres. This wide variation may be explained by differences in the availability of NIV and differences with respect to adherence to clinical guidelines. In Aalesund, although only 10% of the cases had respiratory acidosis, 22% of the admitted patients had been treated with NIV. This liberal use of NIV was probably due to NIV being easily available at the ward and thus used more liberally than what is recommended in most guidelines. In comparison, audits from UK 1997, US 2001 and Denmark 2000, found that only 3–4% of the patients admitted for COPD were given ventilatory assistance.[2,10,19]

Antibiotics were administered during in-hospital care in 66% of the cases compared to 80–85% found in UK and US audits.[2,10] Moreover, in a smaller Danish study, 53% of the patients were given antibiotics.[19] These between-country variations are more likely to be explained by differences in study inclusion criteria and national guidelines than differences in the prevalence of bacterial infections. As criteria for antibiotic therapy were not registered in the present study, the proportion of ideal candidates for antibiotic therapy cannot be measured.[20]

In 20% of the cases, the patient did not receive systemic steroid treatment during the hospital stay. This may represent an under treatment of patients hospitalized for COPD or a result of including patients with mild COPD and concurrent pneumonia. It could also be due the presence of diabetes or gastric ulcers which would make the physician hesitate to use oral steroids.

Ninety-one percent of the cases underwent chest radiography which is in keeping with the findings from a large US audit where 95% of the patients had a chest radiography done.[2] In an UK audit of cases admitted for COPD, a comment on the chest radiograph was recorded within the first 24 h in 65% of the admissions.[10] Surprisingly, among those with main discharge code J13-18, 29% had no pulmonary infiltrate, and among those with main discharge code J43–J44 a pulmonary infiltrate was found in 14% of the cases. This finding demonstrates the heterogeneity of COPD hospitalizations and further underlines the need for standardized coding procedures in order to make international comparisons.

In as many as 28% of all cases no data on pre-admission disease stage was found and only in 22% of the cases was a spirometry performed during the hospital stay. One may argue that knowledge of patient's lung function is vital in all admissions for COPD. Despite this, 19% of all patients were discharged without any accessible spirometry data. In an US audit, spirometry was considered a non-beneficial measure and was done in only 12% of all admissions for COPD exacerbation.[2] In the UK, where guidelines recommend confirmation of a clinical diagnosis with spirometry, Roberts et al. found that only 53% of the cases had FEV_1 documented 5 years prior or 3 months post-discharge.[10] In

the present study twice as many patients were given physiotherapy (18%) compared to an US study from 2001 where only 6.2% of the patients received physiotherapy.[2]

In the present study mean length of hospital stay was 8.6 days. In comparison, audits from UK, US and Denmark have found in-hospital stays from 5.3 to 9.9 days.[2,3,19] All three centres had low in-hospital mortality (3.7%). An UK audit from 2003, an US audit from 2001, and a Danish audit from 2000 found an in-patient mortality of 7.4%,[3] 4.4%,[2] and 9%,[19] respectively. The liberal use of NIV may partly explain the lower in-hospital mortality found in the present study, but this needs to be further elucidated.

Generalisability, implications and opportunities for improvement

The authors believe that many of the presented results may be generalised to other centres, at least in the Scandinavian countries where by large the health care systems are organized equally. Furthermore, the present audit provides data for national and international comparisons as well as longitudinal follow-up studies.

The study results have provided important information for immediate improvement of the clinical care at the participating centres. Like what has been found in previous audits, a significant number of COPD patients were discharged without any medical record documentation of their lung function. This is a challenge to many centres where patients with COPD exacerbations are being treated. An increased focus on early discharge schemes and integrated follow-up strategies will probably have the potential to reduce the length of stay and the frequency of COPD hospitalizations, and thus reduce the costs of hospital care.

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Conflict of interest statement

The authors have no conflicts of interest to declare.

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